Investigate the Noise Pollution Effect on the Operators of Al-Zawiah Electrical Power Station

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الملخص:

للضوضاء تأثير مباشر على صحة الأنسان مثل اضطراب النوم وقلة التركيز ،زيادة نبضات القلب، ونقص قدرة السمع بالإضافة الى امراض أخرى تتعلق بالجهاز العصبي للإنسان.

الهدف من هذا البحث هو دراسة تأثير الضوضاء على مشغلي محطة توليد الكهرباء بالزاوية. تم تقسيم المحطة الى 6 مواقع تم اختيار المواقع بناءا علي تعليمات الادارة علي الاماكن الاكثر ضوضاء وكذلك التي تحتاج الي اخذ قراءات و كشف دوري. وقياس شدة الضوضاء في هذه المواقع لمدة 5 أيام عمل فعلي متوالية. بناء على نتائج القياسات المتحصل عليها وبمقارنتها مع بمقياس الضوضاء (أو أس أتش أيه) تبين لدينا أن درجة الضوضاء في المحطة تختلف من موقع الى آخر وعليه تم تقسيم المحطة الى اربع مناطق بناء على درجة الضوضاء والمدة الزمنية المسموح بها للعمل في هذه المناطق. يحتوي هذا البحث على توصيات هامة يجب اتباعها لتفادي تأثير الضوضاء على مشغلي محطة توليد الكهرباء بالزاوية.

Abstract:

Noise is an unwanted or damaging sound that may damage a human hearing and may causes other health effects such as stress, hypersensitivity to noise, increasing in blood pressure and

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increasing heart rate. It can also interfere with communication at work, which could lead to accidents. These may happened due to effects to the performance of working people at many industrial locations, such as a power stations.

The present study was investigated the effect on noise of Al-Zawiah Electric Power Station (Libya) on the workers during one shift. The selected study cases were six locations by co-coordinating with the management of power station, which expected to have high level of sound pressure during the operation and maintenance. This location has been rotten inspection or taken reading rotten. The experimental activities were done by an appropriate equipment which recommended by Occupational Safety and Health Administration (OSHA). According to the results, the power station divided into different safety regions by comparing the noise readings with OSHA standard, they are save slightly save and un-save regions.

Keywords: (Noise, Electric Power Station, Human hearing safety, OSHA Standard).

1. Introduction

1.1. General

the perceptual analysis of sounds that the complex pattern of sound waves may be classified as “Gestalts” and labeled noise, music, speech, etc. From a physical point of view there is no difference between the concepts sound and noise, although it is an important distinction for the human listener Noise is a class of sounds that are considered as unwanted. In some situations, but not always, noise may adversely affect the health and wellbeing of individuals or populations. Since long agreed among experts, it
is not possible to define noise exclusively on the basis of physical parameters of sound. Instead, it is common practice to define noise

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operationally as audible acoustic energy that adversely affects, or may affect, the physiological and psychological wellbeing of people [1].

Noise is one of the most common pollutants. It is often ignored because it is Colorless, Odorless, and tasteless. And yet it can have negative effects on human well-being [2].The normal range of hearing for a healthy young person is from approximately 20 Hz (Hertz) to 20,000 Hz (20 kHz). Human ears are more sensitive to the middle frequencies, which range from 500 Hz to 4000 Hz - the speech frequencies [3].

1.2. Types of Noise

Continuous Noise: is produced by machinery that operates continuously, such as, gas turbine and pumps [4].

Intermittent Noise: is when machinery operates in cycles. regular or Irregular period operate and difference in noise level such as pump operate on time to time when pressure has beendropin the system. [4].

Impulsive Noise: is the noise from impacts or explosion such as safety valve on high pressure pipe transmit [4].

1.3. Tones in Noise

Annoying tones as mosquito sound or same thing like this. such as motors, gearboxes and fans or pumps often create tones. Because has been Unbalance or high vibration.[5]

2. Literature Review

2.1. Physics of Noise (Sound)

As sound energy travels through the air, it creates a sound wave that exerts pressure on receivers such as an ear drum or microphone. Sound pressure is typically measured in microPascal (μPa) and converted to a sound pressure level in decibels (dB) for reporting purposes. The decibel scale is a logarithmic scale relative to the human threshold of hearing. Sound pressure level is used to determine loudness, noise exposure, and hazard assessment [4].

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2.2. Economic Impact of Noise Pollution

Noise-induced hearing loss is one of the most common occupational injuries, resulting in health problems for many workers and it presents a significant social and economic cost to Libya. The human cost is also high. This includes lost jobs, increased absenteeism, reduced performance, lost opportunities for promotion or other employment and impaired family and social relationships. In addition, if your hearing is damaged it could cause a workplace accident. The first sign of noise-induced hearing loss is often the difficulty to hear high-pitched sounds, such as consonants (e.g. ‘t’, ‘d’, ‘s’) and the voices of women and children. When more than one person is speaking or there is a background noise, the problem becomes worse. Noise-induced hearing loss occurs gradually over a long period of time and unfortunately, hearing loss is permanent.

3. Noise Level Meter Devices

There are many types of noise level meter device. We will payattention to a dosimeter level meter because it's the used device in our study.Dosimeters are widely used for monitoring noise in workplace environments where sound levels may be hazardous to hearing. Basically, the dosimeter integrates a weighted function of sound pressure or sound pressure level over a time period to determine noise dose, which is a percentage of permissible exposure criteria [7]. In our study we have been used a dosimeter model number CEL-360 which is shown in figure (1).

Figure 1. Dosimeter model number CEL-36

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4. Standards of Safety Noise

Today, the literature is lacking in terms of deeming a noise prevention program successful. Perhaps the success in the field is the enforcement of prevention programs in workplaces across the nation as determined by organizations such as Organization Safety Health Association (OSHA). This standard was created by the Occupational Safety and Health Act of 1970. It concerns with noise exposures began primarily in the workplace [6].

Table 1. shows the duration (in hours) of allowable exposures based on OSHA criteria, where (PEL) is the Permissible Exposure Limit [8].

(Table1) OSHA PEL standard [6]

Levels in dB A	85	88	90	92	95	97	100	102	105	110	115
OSHA PEL	16:00	10:00	08:00	06:00	04:00	03:00	02:00	1:30	1:00	00:50	00:25 or less

According to data in table (1), permits exposures of 85 dB for 16 hours per day, and uses a 5-dB time-intensity tradeoff: for every 5 dB increase in noise level, the allowable exposure time is reduced by half. For every 5 dB decrease in noise level, the allowable exposure time is doubled. All time/intensity values shown on the OSHA PEL line in table (1). Are assumed to have equal risk to each other, that is, 16 hours at 85 dB carries the same auditory risk as 8 hours at 90 dB, 4 hours at 95 dB, 2 hours at 100 dB, and so on.

5. Research Methodology

5.1. Introduction:

Al- Zawiah Electric power station is one of most important of stations of the General Electric Company in Libya. It's located at north west of Al-Zawiah, about 45 km from Tripoli It consists of

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three steam turbine and six gas turbine units with capacity of 1400 MW. The total station manpower is around 296person [7]

5.2. Noise Measurements Steps:

(Step A): Noise Source Classification:

After several visits to the station area and our discussion with the top and middle level management about the source of noise in the station, we have decided to classify the station to six locations (X1, X2, X3, X4, X5, X6) namely as the followings:

X1 location: Low Pressure Feed Pump (STU3):

This pump very important where it provide the steam turbine to low pressure steam. Has been inspection and reading rotten.

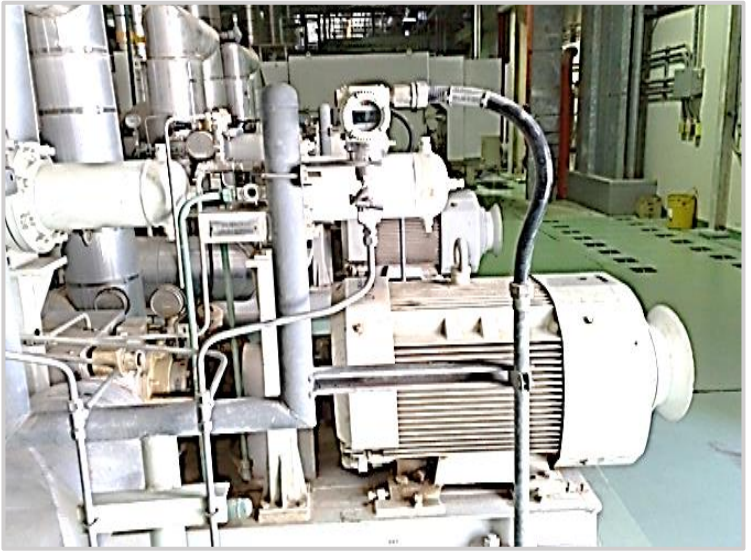

Figure 2. X1 location: Low Pressure Feed Pump (STU3).

X2 location: **6 meters away of location X1 (STU3):**

This equipment has been reading rotten one of important stage in create steam.

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Figure 3. X2 location: 6 meters away of X1 location.

X3 location: **Area in between X1 and X2 Locations:**
This location has been two important control valves.

Figure 4. X3 location: Area in between X1 and X2 locations.

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X4 location: **High pressure feed water pump (STU2):**

This pump is very important where it provide the steam turbine to high pressure steam. Has been inspection and reading rotten.

Figure 5. X4 location: High pressure feedwater pump (STU2).

X5 location: **Fuel forwarding pump unit, (FFPU).**

This pump very important where it provide the gas turbine with light fuel. Has been inspection and reading rotten

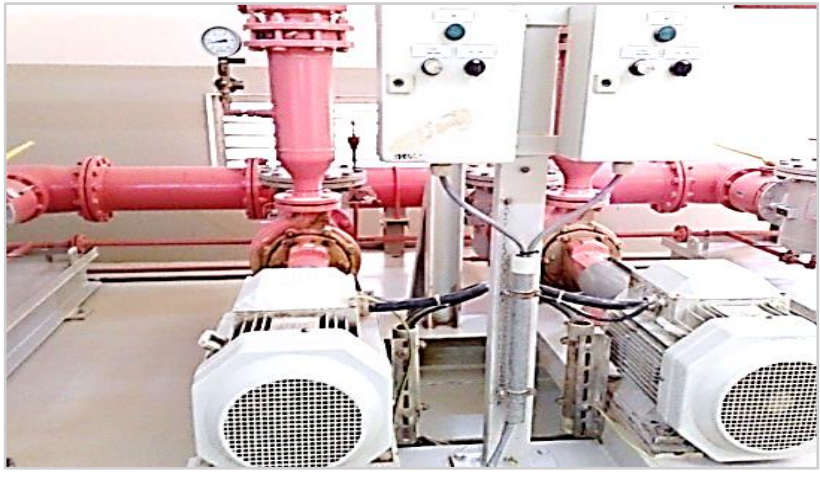

Figure 6. X5 location: Fuel forwarding pump unit (FFPU).

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X6 location:**Trust bearing joint between compressor and generator room, (GT14).**

This location joint between compressor and generator room. it has been reading rotten temperature and pressure indicator

Figure 7. X6 location: Trust bearing joint between compressor and generator room, (GT14).

5.3. Tests Procedure:

The noise readings have been taken for the six locations using a device of noise measurement. This procedure has been done for a continued five days. The device has registered the noise minimum and maximum levels for five minutes in each site. In the present work we have compare the maximum levels which have been taken during the five days with theOSHA standard in order to identify the allowed and non - allowed working period time.

6. Results

The following figures showing the measurement at each location in the electric power station.

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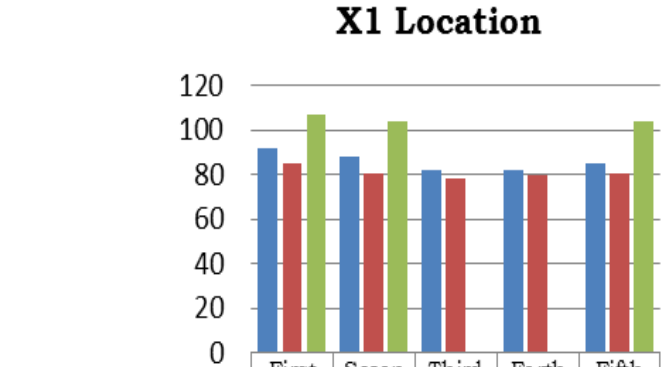
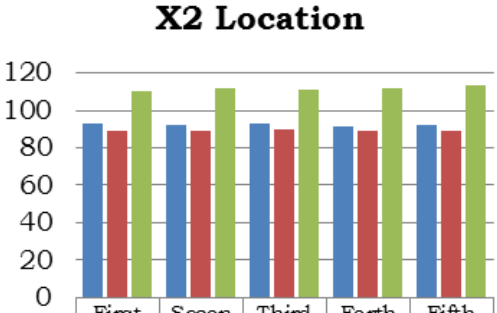


	First day	Second day	Third day	Forth day	Fifth day
max level	91.8	88.3	81.8	82	85.1
min level	85.2	80.2	78.5	80.1	80.9
peak exceedance level	106.7	104.1	0	0	103.8

Figure 8. Max, min and peak exceeding level at location X1, STU3



	First day	Second day	Third day	Forth day	Fifth day
max level	92.9	91.9	92.7	91.5	91.9
min level	89.2	89.1	90.1	88.7	89
peak exceedance	110.6	112	111.2	111.6	113

Figure 9. Max, min and peak exceeding level at location X2, STU3

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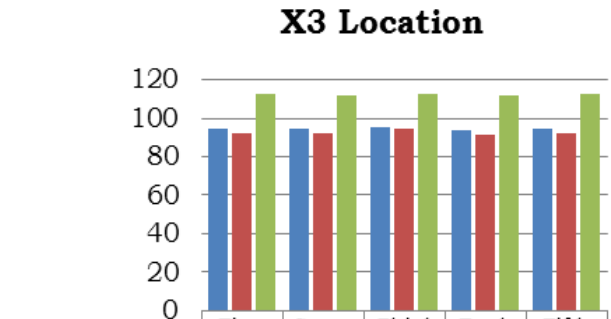
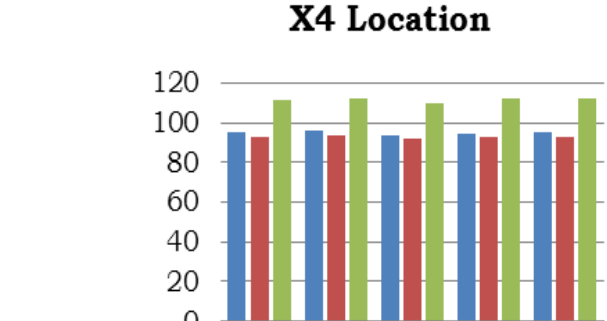


	First day	Second day	Third day	Forth day	Fifth day
max level	94.5	94.7	95.3	93.9	94.7
min level	91.8	92.1	94.2	91.7	92.1
peak exceedance	112.6	111.8	112.3	111.5	112.6

Figure 10. Max, min and peak exceeding level at location X3, STU3



	First day	Second day	Third day	Forth day	Fifth day
max level	95.2	95.8	93.7	94.9	95.4
min level	92.8	94.1	92	92.7	93.3
peak exceedance level	111.7	112	110	112.1	112

Figure 11. Max, min and peak exceeding level at location X4, STU3

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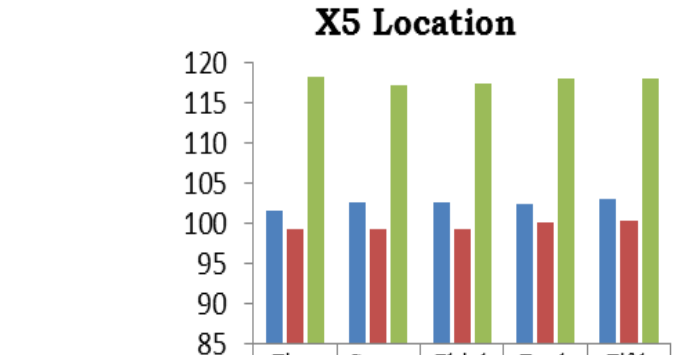
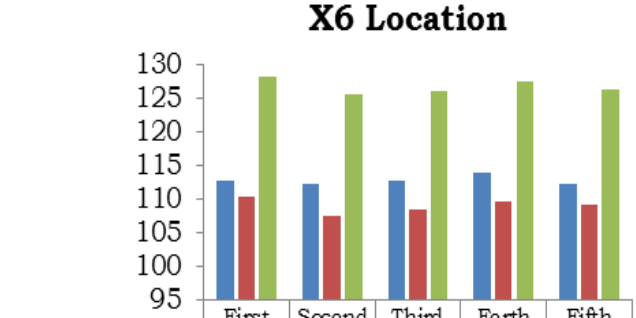


	First day	Second day	Third day	Forth day	Fifth day
max level	101.7	102.7	102.6	102.5	103.2
min level	99.3	99.4	99.4	100.2	100.3
peak exceedance level	118.2	117.3	117.4	118.1	118

Figure 12. Max, min and peak exceeding level at location X5, STU3



	First day	Second day	Third day	Forth day	Fifth day
max level	112.7	112.3	112.8	113.8	112.3
min level	110.2	107.5	108.4	109.5	109.1
peak exceedance level	128.2	125.7	126	127.4	126.4

Figure 13. Max, min and peak exceeding level at location X6, STU3

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The following Arithmetic mean formula was used to calculate the average of minimum and maximum reading during the five days for each location [8]: $Xmean = \frac{Thesumofvalues}{Nmberofvalues}$

Table 2 shows the average of maximum and minimum readings at each location in the electric power station.

Table 2. Average of the maximum and minimum readings for each location in the electric power station.

Location	Average of max. sound level (dB)	Average of min. sound level (dB
X1	85.80	80.98
X2	92.18	89.22
X3	94.62	92.38
X4	95.00	92.98
X5	102.54	99.72
X6	112.80	108.94

Table 3. Comparing the average of the maximum readingswith OSHA criteria, in order to evaluate the Permissible Exposure Limit (PEL)

Location	Average of max. sound level (dB)	PEL (hrs)
X1	85.80	16
X2	92.18	6
X3	94.62	4
X4	95.00	4
X5	102.54	1.3
X6	112.80	0.25

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7. Discussion and Analysis

7.1. At X1 location: According to table (4), the average of maximum sound level is lower than 90 dB, thus the workers in this location can work in this location safely.

7.2. At X2 location: the average of maximum sound level is 92.18 dB, and according to OSHA standard, workers in this location must not allowed to work in this location more than 06:00 hours.

7.3. At X3 location: the average of maximum sound level is 94.62 dB, and according to OSHA standard, workers in this location must not allowed to work in this location more than 04:00 hours proximately.

7.4. At X4 location: the average of maximum sound level is 95.00 dB, and according to OSHA standard, workers in this location must not allowed to work in this location more than 04:00 hours.

7.5. At X5 location: the average of maximum sound level is 102. dB, and according to OSHA standard, workers in this location must not allowed to work in this location more than 01:30 hours.

7.6. At X6 location: the average of maximum sound level is 112.80 dB, and according to OSHA standard, workers in this location must not allowed to work in this location more than 00:20 hours.

According to the sound level measurements, the electric power station classified to four regions of machinery noise effects on the station workers based on the OSHA standard. These regions are shown on figure (14).

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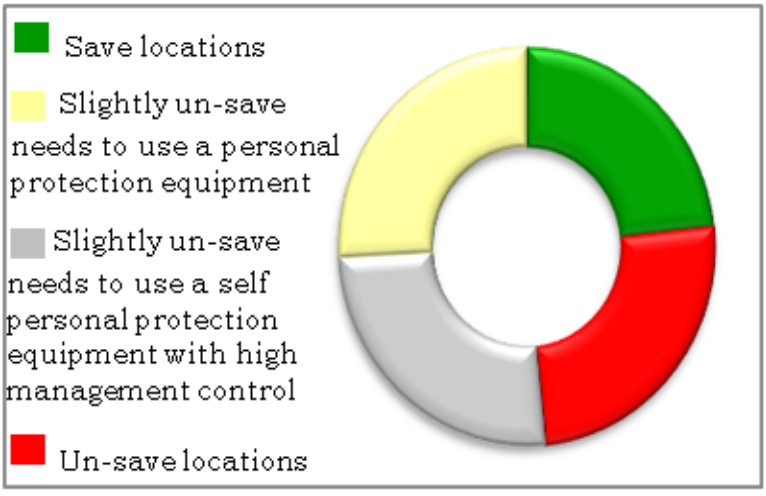
Save locations
Slightly un-save needs to use a personal protection equipment
Slightly un-save needs to use a self personal protection equipment with high management control
Un-save locations

Figure 14. Classification of machinery noise effects on the station workers

8. Conclusions and Recommendations

8.1. Conclusions

Noise hazard is one of the major disturbing factors in human everyday life. It causes annoyance, difficulties in concentration and performing tasks, and hearing impairments. Moreover, the continuous exposure to noise leads to non-auditory health disorder. In order to investigate the effect of machinery noise of Al-Zawiah Electric Power Station on the workers, the station was divided in six different locations, and the maximum and minimum noise measurements were taken at each location during five working days. The locations were chosen, because of their inclusion of high pressure and high temperature gauges, which need to be checked in the daily basis for long time from the work period.

According to the results, the power station divided into different safety regions by comparing the noise readings with OSHA standard, they are Save, slightly save and un-save regions.

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8.2. Recommendations

1- Educate employees and officials about dangers of noise.

2- Awareness courses for operating and maintenance workers in occupational safety and noise hazard are needed, because of the gradually effect of the noise begins with turbulence in sleep fragmentation, lack of focus, an advanced stage of blood pressure and hearing loss may lead to death.

3- Taken tough decisions management to the workers they require developing protecting them self by using earplug to reduce noise.

4- To provide the employees by noise measurement equipment to determine the noise levelin dangerplaces.

5- Routine screening devices and routine maintenance and periodic lubrication of machines to reduce noise sources of noise, especially in the rotating parts such as pumps and the like.

6- Employers must be taken into account the reduction of working hours in some places which have unpermitted noise according to OSHA standard.

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